TO DETERMINE THE VALUE ADDITION IN THE COMPOST AND VERMICOMPOST PRODUCED FROM KITCHEN WASTE

A Synopsis

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INTRODUCTION

Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. It may be categorized according to its origin (domestic, industrial, commercial, construction or institutional); according to its contents (organic material, glass, metal, plastic paper etc); or according to hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc).

Solid waste is a burning and a critical issue of today as rapid growth in population is directly associated in the generation of solid waste which further contaminates available natural resources air, water and land. Solid waste may be defined as a material that has no value to a person who is responsible for it. Solid waste may be any garbage, refuse, sludge and other discarded material which may be solid, semisolid having gaseous material obtained from industrial, commercial, mining and agricultural operations, and also from community activities (like construction waste, household junk such as furniture, appliances and equipments etc.). Typical solid waste is leather, rubber, paper, wood and other combustible materials.

Solid waste consists of highly heterogeneous mass of discarded materials from residential, commercial, agricultural and mining activities (like construction waste, household junk such as furniture, appliances, equipments, etc). The refuse materials such as cotton pieces, foodstuff, skin, newspaper, clothes, leather, old dress, fish etc., anything of solids produced by the humans is going to become a waste some time somewhere and somehow. It shows waste material is produced as a result of human activity. The quantity of this material is increasing readily due to increase in human population and increase in the standards of living. These wastes have to be disposed off so that environment remains clean and healthy for inhabitation. Solid waste management includes the process of generation, collection, storage, transport and disposal or reuse and re-circulation or incineration or any relevant method of disposal (WHO, 1971).

In India due to population explosion and rapid industrialization people migrates from villages to cities, which generate thousands of tons of MSW daily. The MSW amount is expected to increase significantly in the near future as the country strives to attain an industrialized nation status by the year 2020 Sharma and Shah (2005), CPCB (2004) Shekdar *et al*. (1992). Accumulation is because of poor collection and inadequate transportation.

A number of processes are involved in managing waste for a municipality. These include monitoring, collection, transport, processing, recycling and disposal.Management of solid waste reduces adverse impacts on the environment and human health and supports economic development and improved quality of life.

Different methods of waste reduction, waste reuse and recycling are the preferred when managing waste from which many environmental benefits that can be derived. They reduce or prevent greenhouse gas emissions, reduce the release of pollutants, conserve resources, save energy and reduce the demand for waste treatment technology and landfill.

Household kitchen waste is one of the major sources of municipal solid waste. In India, domestic waste is mostly of organic nature and contributes 70% to 80% of urban solid wastes. Each household

of four family members generates 0.5-0.75 kg kitchen wastes per day (Kale 1998). Food waste has a significant public health impact; it rots, smells bad, and attracts rodents and insects. Food waste drives Municipal Solid Waste (MSW) collection frequency, the major cost of MSW management. Landfilling adds an additional cost. It also generates greenhouse gasses during decomposition, while the energy value and the soil nutrient value are lost. Food waste reduction from MSW has the potential to decrease greenhouse gas emissions, public health issues, MSW collection frequency and MSW management costs, increase renewable energy production, and provide nutrients to our soils.

Food is the most important necessities in our daily lives. We would not be able to survive without it. And since we consume it every day, it is also the major source of waste. Excess trimmings of vegetables, cooked or uncooked leftovers, fruits, and all of the edible matters that are usually found in our kitchens come in just very small quantities. Restaurants, hotels, food chains, food factories, and big establishments have bigger contributions to add to the mix.

Food waste is food that is discarded or lost uneaten. As of 2011, 1.3 billion tons of food, about one third of the global food production, is lost or wasted annually. Loss and wastage occurs on all steps in the food supply chain.

Definitions of food waste vary, among other things, in what food waste consists of, how it is produced, and where or what it is discarded from or generated by. Definitions also vary because certain groups do not consider (or have traditionally not considered) food waste to be a waste material, due to its applications. Some definitions of what food waste consists of are based on other waste definitions (e.g. agricultural waste) and which materials do not meet their definitions.

Food waste can be composted at home. However, the proportion of the population willing to dispose of their food waste in that way may be limited.A compost pile is an ideal way to recycle organic wastes from our home and community. If properly managed, a compost pile will kill pathogens and weed seeds.Compost will provide nutrients to the plants - not only nitrogen, potassium and phosphorus, but also the secondary and trace elements.Compost is a good way to improve the physical properties of the soil, such as drainage, aeration, ability to retain nutrients and water, both on sandy and clay soils.

The management of different wastes requires different kinds of procedures to handle the waste as different toxic compounds present in one type of waste may not be present in the other. But, many firms aim in utilizing all natural ways of handling the waste in a natural or ecofriendly manner, which can be also used for conversion of solid kitchen waste into compost by using compost solutions. Compost solutions can be used for Municipal Solid Waste, Kitchen and horticulture waste, animal waste, sludge and other biodegradable waste. Main ingredients of these solutions are natural and environment friendly.

A process related to composting which can improve the beneficial utilization of organic wastes is vermicomposting. Vermicomposting is a non-thermophilic process by which organic materials are converted by earthworms and microorganisms into rich soil amendments with greatly increased microbial activity and nutrient availability.

It is a method of preparing enriched compost with the use of earthworms. It is one of the easiest methods to recycle wastes and to produce quality compost. Earthworms consume biomass and excrete it in digestedform called worm casts. Worm casts are popularly called as Black gold. These casts are rich in nutrients, growth promoting substances which are beneficial for soil micro flora and having properties of inhibiting pathogenic microbes.

For the composting process to work effectively, material to be composted should have a carbon to nitrogen ratio of 30 to 1. This cannot be measured easily, but experience has shown that mixing equal volumes of green plant material with equal volumes of naturally dry plant material will give approximately a 30/1 carbon to nitrogen (C/N) ratio. Green material can be grass clippings, old flowers, green prunings, weeds, fresh garbage and fruit and vegetable wastes. Dried material can be dead, fallen leaves, dried grass, straw and somewhat woody materials from prunings. Such materials are easy to find in fall and early spring but are more difficult to find in the growing season. During this time, paper bags, cardboard boxes, cereal and milk cartons, and paper can be used for dried materials but they must be finely chopped or shredded. Newspapers can be used if shredded and separated by plant tissues so they do not mat - matting is bad because oxygen is necessary for rapid decomposition and matting excludes oxygen. Any material which is cut green and is allowed to dry is considered green. Some green materials, such as grass clippings also may mat if care is not taken to separate them using dry materials.

Aristotle called worms the “intestines of the earth” and stated that there may not be any other creature that has played so important role in the history of life on earth. Earthworms contribute a large part of biomass inhabiting soil. Scientific rearing of earthworms, their reproduction, nutrition and conservation come under vermiculture. Biotechnology and the earthworms are used in degradation of organic waste and the product after degradation is known as vermicompost.

Vermicompost is stable, fine granular organic manure, which enriches soil quality by improving its physicochemical and biological properties. It is highly useful in raising seedlings and for crop production. Vermicompost is becoming popular as a major component of organic farming system.

There are an estimated 1800 species of earthworm worldwide (Edwards and Lofty, 1972). There are different species of earthworms viz. *Eisenia foetida* (Red earthworm), *Eudrilus eugeniae* (night crawler), *Perionyx excavatus* etc. *Eisenia foetida* is preferred because of its high multiplication rate and thereby converts the organic matter into vermicompost within 45-50 days. Since it is a surface feeder it convertsorganic materials into vermicompost from top. One kg earthworms can consume one kg materials in a day. They secrete vermicompost which are rich in Calcium, Magnesium, Potassium, Nitrogen, useful microrganisms, hormones, enzymes and vitamins and certain micronutrients needed for plant growth (Lee 1985, Bansal and Kapoor, 2000).

The present study consists of composting of food waste and its value addition to the produced compost, vermicompost and the compost prepared by using different liquid composter (A, B and C) which can be used for conversion of solid kitchen waste into compost and to prepare a value added solution to convert kitchen waste into a useful product.

OBJECTIVES

- ✓ To manage the kitchen waste and convert them into useful product for better growth and quality of crops.

- ✓ To evaluate the physicochemical parameters of the kitchen waste collected.

- ✓ To evaluate the physicochemical parameters of the vermicompost produced from the kitchen waste.

- ✓ To evaluate the physicochemical parameters of the compost produced from the kitchen waste by usingthreedifferent liquid composters.

- ✓ To assess and thereafter compare the value addition in vermicompost and composts A, B and Cproduced from kitchen waste.

- ✓ To prepare a value added solution to convert kitchen waste into a useful product.

REVIEW OF LITERATURE

Accumulation of waste is due to poor collection and inadequatetransportation. Due to the unavailability of suitable facilities to treat and dispose of the larger amount of MSW generated daily in metropolitan cities, the management of MSW is going through a critical phase. Unscientific disposal causes an adverse impact on all componentsof the environment and human health Rathi, (2006) Sharholy *et al.* (2005) Ray *et al.* (2005) Jha *et al.*(2003) Kansal (2002) Kansal *et al.* (1998) Singh and Singh (1998)Gupta *et al.* (1998).

Incineration and landfill have until now been the most widely used means of solid waste disposal throughout the world, the land filling of biodegradable waste is proven to contribute to environmental degradation, mainly through the production of highly polluting leachate and methane gas. Methane constitutes one of the six greenhouse gases responsible for the global warming, which needs to be reduced, in order to tackle climate change under the Kyoto Protocol (UN, 1998). The methane emissions from landfills constitute about 30% of the global anthropogenic emissions of methane to the atmosphere (COM, 1996).

A review of existing literature reveals that a great number of studies on SWM have been undertaken, even prior to 1970 (van Beukering *et al*. 1999). Regarding the 'waste management hierarchy' it needs to be added that in developing countries a large quantity of the waste is dumped in an uncontrolled manner, or, worse, burned in the open air. These practices obviously form the lowest level of the hierarchy and they are not laudable principles to strive for (van Beukering *et al*. 1999).Earlier studies show that the prime consideration management of the public officials was the quick waste removal and destruction (Melosi, 2005).

With the rise of towns and cities where large numbers of people started to congregate in relatively small areas in pursuit of livelihoods, waste disposal became problematic (Shafiul and Mansoor, 2003).According to Ogawa (2005), a typical solid waste management system in a developing country displays an array of problems, including low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control.

In Municipal Solid Waste Management (MSWM) of developing countries typical problem areas can be identified. 1) inadequate service coverage and operational inefficiencies of services, 2) limited utilization of recycling activities, 3) inadequate landfill disposal, and 4) inadequate management of hazardous and healthcare waste (Zurbrugg, 2003). The need to understand community participation and community-based environmental management initiatives have been addressed by researchers and concerned institutions for the several years now (Richardson, 2003, Omran *et al*. 2006, Omran and Gavrilescu, 2008).

Without doubt, untreated solid wastes frequently contain components that have the potential to cause infectious diseases. The level of this potential remains largely not assessed, but more current treatment process can either totally or consistently eliminates such risks (Hamer, 2003).

Events of the 20thand early into the 21stcentury indicate that waste in whatever form or classification-solid, liquid or toxic have become a major consequence of modernization and economic development (Tsiboe and Marbell, 2004). Tchobanoglous *et al.*(1993) has further explained the types of solid waste which include food waste, rubbish, ashes and residues and special waste.

The Centre for Environment and Development (2003) has also classified types of solid waste based on origin (food waste, rubbish, ashes and residues, demolition and construction, agriculture waste), based on characteristics (biodegradable and non-biodegradable), based on the risk potential (hazardous waste). The Centre also enumerated sources of solid waste as residential, waste from shops, commercials establishment, hotels/restaurants/eating stalls, slaughter houses and others. This has confirmed the sources and types of solid waste outlined by Tchobanoglous *et al.*(1993).

Household kitchen waste is one of the major sources of municipal solid waste. In India, domestic waste is mostly of organic nature and contributes 70% to 80% of urban solid wastes. Each household of four family members generates 0.5-0.75 kg kitchen wastes per day (Kale 1998).

In recent years, increasing consumer concern about issues such as food quality, environmental safety and soil conservation has lead to a substantial increase in the use of sustainable agricultural practices. Sustainable agriculture can be defined as a set of practices that conserve resources and the environment without compromising human needs, and the use of organic fertilizers such as animal manure has been indicated as one of its main pillars(Tilman *et al.* 2002).The use of manure in agriculture is being abandoned because of increasing transportation costs and environmentalproblems associated with the indiscriminate and inappropriately timed application to agricultural fields (Hutchison *et al*. 2005). Sajjad Haydar and Junaid Masood, 2011,have made efforts to find a technique for reducing the amount of solid waste being collected and dumped. For this purpose kitchen waste composting was studied.

Composting in a way is one such method by which wecan practically and economically use those waste streams dominated by organic refuse. As stated by Roger (1993) that there is no universally accepted definition of composting.According to him, it is the biological decomposition and stabilisation of organic substrates, under conditions that allow development of thermophilic temperatures as a result ofbiologically produced heat, to produce a final product that is stable, free of pathogens andplant seeds, and can be beneficially applied to land. Or simply it can be defines as the

biological reduction of the organic waste to humus (Jerry, 1979). In brief we can considercomposting as a way of stabilising the waste.

Composting involves the accelerated degradation of organic matter by microorganisms under controlled conditions, in which the organic material undergoes a characteristic thermophilic stage that allows sanitization of the waste by the elimination of pathogenic microorganisms (Lung *et al*. 2001). Composting is a biochemical process in which organic materials are biologically degraded, resulting in the production of organic or inorganic by products and energy in the form of heat (Hogos *et al.* 2002). Heat is trapped within the composting mass, leading to the phenomenon of self-heating that is characteristics of the composting process (Semple *et al.* 2001). According to Zerbock (2003), a low-technology approach to waste reduction is composting.During composting, microbial decomposition aerobically transforms organic substrates into a stable, humus-like material (Brown and Subler, 2007). In composting, microbes degrade the original waste materials into organic compounds through a variety of pathways. During this decomposition, approximately 80 percent of the initial organic matter is emitted as CO_2 (Beck-Friis *et al*. 2000). The remainder of the organic compounds eventually stabilize and become resistant to further rapid microbial decomposition (i.e., recalcitrant) (Francou *et al.* 2008). Mature compost is characterized as containing a high percentage of these stable, humic substances. When the compost is mature, nearly all of the water-soluble compounds (such as dissolved organic carbon) will have leached out (Bernal *et al.*1998). Compost land application completes a circle whereby nutrients and organic matter which have been removed in the harvested produce are replaced (Diener *et al*.1993).

The results of several long-term studies have shown that the addition of compost improves soil physical properties by decreasing bulk density and increasing the soil water holding capacity (Weber *et al*. 2007). Moreover, in comparison with mineral fertilizers, compost produces significantly greater increases in soil organic carbon and some plant nutrients (García-Gil *et al*. 2000, Bulluck *et al.* 2002, Nardi *et al*. 2004, Weber*et al*. 2007).Long-term beneficial effects of composted materials are also observed in soil humic substances (due to an increase in the complexity of their molecular structure, which increases the humic/fulvic acid ratio), as well as in soil sorption properties (with increased cation exchange capacity and base saturation) (Weber *et al*. 2007). In addition to the changes exerted on the chemical and physical properties, composted materials have a clear impact onsoil biological properties, such as increases in microbial biomass and activity (Knapp *et al.* 2010), as well as

changes in the activity of soil enzymes (Garcia-Gil et al. 2000, Ros *et al.* 2006) and in the structure of the soil microbial community (Ros *et al*. 2006). Composts made from organic wastes; when applied on land; increase soil organic matter and supply plant nutrients in a slowly available form (Hartz *et al.* 1996; Smith *et al.*1992; Shanks and Gouin, 1989).For example, Smith *et al.* (1992) reported significantly higher yield of field-grown cabbage and onion when the soil was fertilized with 25% compost.

During composting, the microorganisms use the organic matter as a food source. The process produces heat, carbon dioxide, water vapour and humus as a result of growth and activities of microorganisms (Tiquia, 2005). During the process bacteria, fungi and other microorganisms, including micro arthropods, break down organic materials to stable, usable organic substances called compost Bernal *et al*. (2008). It is also known as a biological reduction of organic wastes to humus or humus like substances (Gautam *et al.*2010). The recycling of compost to land is considered as a way of maintaining or restoring the quality of soils, mainly because of the fertilizing or improving properties of the organic matter contained in them. Furthermore, it may contribute to the carbon sequestration and may partially replace peat and fertilizers (Smith *et al.* 2001).

Monitoring of the microbial succession is important in the effective management of the composting process as microorganisms play key roles in the process and the appearance of some microorganismsreflects the quality of maturing compost (Ryckeboer *et al*. 2003).

The interaction between various functional groups of microorganisms depends on nutrient resources and the biochemical mechanisms of organic and inorganic matter transformation changes (Insam *et al*. 2002).

According to SunKee *et al.*(2004), degradation of each component of food waste is affected by environmental conditions. Carbohydrate, cellulose, and protein have their own optimum pH and retention times for degradation (Sridhar and Arinola 1991).The slow release of Nitrogen supplied by food waste composts is ideally suited for urban landscapes where moderate, consistent rate of plant growth is highly desirable (Sullivan *et al*. 2001).

Traditional composting of organic matter wastes has been known for many years but new methods of thermophilic composting have become much more popular in organic waste treatment recently since they eliminate some of the detrimental effects of organic wastes in the soil. Composting has been recognized as a low cost and environmentally sound process for treatment of many organic wastes (Hoitink, 1993). Furthermore, the rapid decomposition and raised temperatures during composting produce a relatively homogeneous, odor-free, pathogen-free and easy-to-handle product. Bevacqua and Mellano (1993) reported that compost treated soils had lower pHs and increased levels of organic matter, primary nutrients, and soluble salts. In crop studies, Bryan and Lance (1991) found that tomatoes grown in compost amended soils yielded more. Maynard (1993) also reported increases in fruit yield of compost amended plants compared with those growing in soil alone. Other benefits from the use of compost include the possible reduction of hazards from nitrate leaching into groundwater compared to those from inorganically fertilized controls (Maynard, 1989).

The key to maximum productivity is maintenance of aerobic condition with optimum moisture and temperature (Edward, 1998). In some cases, organic residues require pretreatment before being vermicomposted as they may contain substancesthat are toxic for earthworms, such as acidic compounds (Nair *et al.* 2006).

Unlike compost, vermicompost is produced under mesophilic conditions, and although microorganisms degrade the organic matter biochemically, earthworms are the crucial drivers of the process, as they aerate, condition and fragment the substrate, thus drastically altering the microbial activity. Earthworms act as mechanical blenders, and by fragmenting the organic matter they modify its physical and chemical status by gradually reducing the ratio of C:N and increasing the surface area exposed to microorganisms thus making it much more favorable for microbial activity and further decomposition (Domínguez *et al*. 2010).

Vermicomposting generally converts organic matter to a more uniform size, which gives the final substrate a characteristic earthy appearance, whereas the material resulting from composting usually has a more heterogeneous appearance (Ndegwa and Thompson, 2001, Tognetti *et al*. 2005). Vermicompost also has a positive effect on vegetative growth, stimulating shoot and root development (Edwards *et al*. 2004).

Scientific investigations have established the viability of using earthworms as a treatment technique for numerous waste streams (Hand *et al*. 1988; Raymond and Neuhauser, 1988,Edwards, 1988, Logsdon, 1994., Harris *et al*. 1990; Edwards and Bohlen, 1996). The action of earthworms in this process is physical/mechanical and biochemical. The biochemical process is affected bymicrobial decomposition of the substrate in the intestines of the earthworms. These physical/mechanical unit processes usually represent the largest cost associated with traditional microbial composting process. Vermicomposting saves on all these unit operations. Hand *et al.* (1988) thus define vermicomposting as a low cost technology system for the processing or treatment of organic wastes.

Under the present condition of environmental degradation vermicomposting technology offers recovery of valuable resources like manure from such biodegradable waste. Vermicomposting is a process of production of vermicompost through stabilization of organic waste by earthworm activity. The process of vermistabilization is due to microbial decomposition of organic matter within the gut of earthworms and thus the undigested released excreta of earthworms do not undergo rapid decomposition (Mitchell, 1997).

Research on vermicomposting of a variety of wastes is gaining momentum throughout the world (Elvira *et al.* 1997; Edwards 1998; Frederickson *et al.* 1997; Kale 1998; Mitchell 1997; Reinecke *et al*. 1992; Singh 1997). However, reports on the chemical changes during breakdown of the organic waste by the activity of the earthworm are scarce (Albanell *et al.* 1988, Ghosh *et al*. 1999).

During the process phosphorous content increased at a fluctuating level while potassium and calcium decreased and the magnesium level remained almost static during composting with and without earthworm. Ghosh *et al*. (1999) reported higher level of transformation of phosphorus from organic to inorganic state and thereby into available forms during vermicomposting compared to ordinary composting. Rise in the level of Phosphorous content during vermicomposting is probably due to

mineralization and mobilization of Phosphorous due to bacterial and faecal phosphatase activity of earthworms (Krisnamoorthy 1990).

Reddy and Reddy (1999) reported significant increases in micronutrients in field soils after vermicompost applications compared to those in soils treated with animal manures.The bacterial activity extremely decreases in moisture content lower than40% in a composting process and it almost stops in lower than 10% (Tchobanoglous *et al.* 1993).

In Vermicomposting, temperatures are kept generally kept below 35^{o}C (Riggle *et al.* 1994). Earthworms tolerate cold and moist conditions far better than they can hot and dry conditions (Slocum, 2001).The soil should not be too wet else it may create an anaerobic condition which may drive the earthworms from the bed. Although studies have suggested that worms perform best in neutral pH (Ronald *et al.* 1977). It has been recorded by Edward *et al.* (1976) that different species of earthworms have their own pH sensitivity and generally most of them can survive at the pH range between 4.5–9. The alteration of pH in the bedding is due to the fragmentation of the organic matter under series of chemical reaction. All organic matter should be added only as a limited layer as anexcess of the former may generate heat (Ismail, 1997). From the waste eaten up by theworms 5 – 10 % is being assimilated in their body and the rest are being excreted in theform of a nutrient rich cast. (Council for Advancement of People's Action and Rural Technology, CAPART, 1998). They are no known stimulants which will force the earthworms to breed but fairlyfresh manure or other nitrogen rich green organic matter seems to be the best stimulant to rapid breeding (Ronald *et al.* 1977).

The worms and the microorganisms actsymbiotically to accelerate and enhance the decomposition of the organic matter (Ronald *et al.* 1977).The distribution of earthworm in the soil is influenced by several factors of which are soil texture and aeration, temperature, moisture, pH, inorganic salts and the organic matter (Govindan, 1998).In their natural habitat, earthworms follow a well-defined yearly cycle. This cycleis considered to starting at the autumn season (Ronald *et al.* 1977). Life cycle of anearthworm is divided into four major phases, (Ismail, 1997). Earthworms can consume more organic matter from the soil surface than all of the other small soil animals together (Ronald, 1977).

When used at lower substitution rates, vermicomposts can increase growth, flowering and yields of vegetable and ornamental crops. Similarly, vermicomposts applied at very low rates e.g. 2.5 t/ha or 5 t/ha can significantly increase growth and yields of highly valuable vegetable and fruits crops in the field. The effects of vermicomposts on plants are not solely attributed to the quality of mineral nutrition is provided but also to its other growth regulating components such as plant growth hormones and humic acids. Furthermore, the application of vermicomposts in the field enhances the quality of soils by increasing microbial activity and microbial biomass which are key components in nutrient cycling, production of plant growth regulators and protecting plants soil-borne disease and arthropod pest attacks.

Earth worms greatly increases the soil fertility, and at least part of this must be due to the increased amounts of mineralized nitrogen that they make available for the plant growth. There have been reports of increase in the amount of nitrogen in which the earthworms are reared (Edward *et al.* 1976). This may be due to the decay of the bodies of dead earthworms. Since the body of the

earthworm are rich in proteins. Govindan (1998) reported that earthworm body contains 65% protein, 14% fats, 14% carbohydrates and 3% ash. Similarly Ronald (1977) reported that 72% of the dry weight of an earthworm is protein and that the death of an earthworm will releases up to 0.01 gram of nitrate in the soil. Earthworms consume large amount of plant organic matter that contains considerable quantities of nitrogen, and much of this is returned to the soil in their excretions. Hand *et al. (*1988) reported that nitrogen mineralization was greater in the presence of earthworms, and this mineral nitrogen was retained in nitrate form.

METHODOLOGY AND WORK PLAN

This Research project consists of composting of food waste and its value addition to the produced compost, vermicompost and the compost prepared by using three different liquid composters, which can be used for conversion of solid kitchen waste into compost.

To achieve the objectives of the present study, the work plan is as follows:

1. Collection of Kitchen waste: Kitchen waste will be collected from canteen and food processing unit of Morarka Foundation, Jaipur.

2. Segregation of Kitchen Waste: Segregation of waste will be carried out for the removal of non-vegetarian material or like egg shells etc.

3. Drying of waste: Drying of waste can be done by three methods:

(i) Saw dust can be mixed.

(ii) Filtration can be done through the specialized dustbins by using a modified filter.

(iii) Food waste can be dumped in a pit approx. 2-3 feet deep.

- Mock experiments will be done to check the appropriate method.

4. Crushing: Crushing of the waste will be carried out.

5. Testing of the physicochemical parameters in the dried and crushed waste for the following parameters:

- Available Phosphorous (Olsen's method)
- Calcium(Atomic Absorption Spectrophotometer)
- Electrical Conductivity (Conductivity meter)
- Exchangeable potassium
- Magnesium(Atomic Absorption Spectrophotometer)
- Moisture Content (%) (Oven method)
- Organic Carbon (Black and Walkley method)
- pH (pH meter)
- Temperature(^{o}C)
- Total Nitrogen (Kjeldhal assembly)

6. Composting:

(i) Preparation of vermicompost using dried Kitchen Waste (Vermicomposting)
(30% cow dung+ 70% waste+ earthworms.
(ii) Preparation of controlled compost withoutany mixing.
(30% cow dung+ 70% waste).
(iii) Preparation of compost (A) using dried Kitchen Waste.
(30% cow dung+ 70% waste+ solution A).
(iv) Preparation of compost (B) using dried Kitchen Waste.
(Waste+ solution B)
(v) Preparation of compost (C) using dried Kitchen Waste.
(Waste+ solution C).

7. Physicochemical analysis: Physicochemical analysis will be carried out of controlled compost, compost prepared by using solutions A, B and C and the vermicompost. Experiment will be carried out in triplicates.

8. Assessment/Comparison of the value addition: The value addition from waste to compost will be analysed by the following parameters.
   - Available Phosphorous (Olsen's method)
   - Calcium(Atomic Absorption Spectrophotometer)
   - Electrical Conductivity (Conductivity meter)
   - Exchangeable potassium
   - Magnesium(Atomic Absorption Spectrophotometer)
   - Moisture Content (%) (Oven method)
   - Organic Carbon (Black and Walkley method)
   - pH (pH meter)
   - Temperature (^{o}C)
   - Total Nitrogen (Kjeldhal assembly)

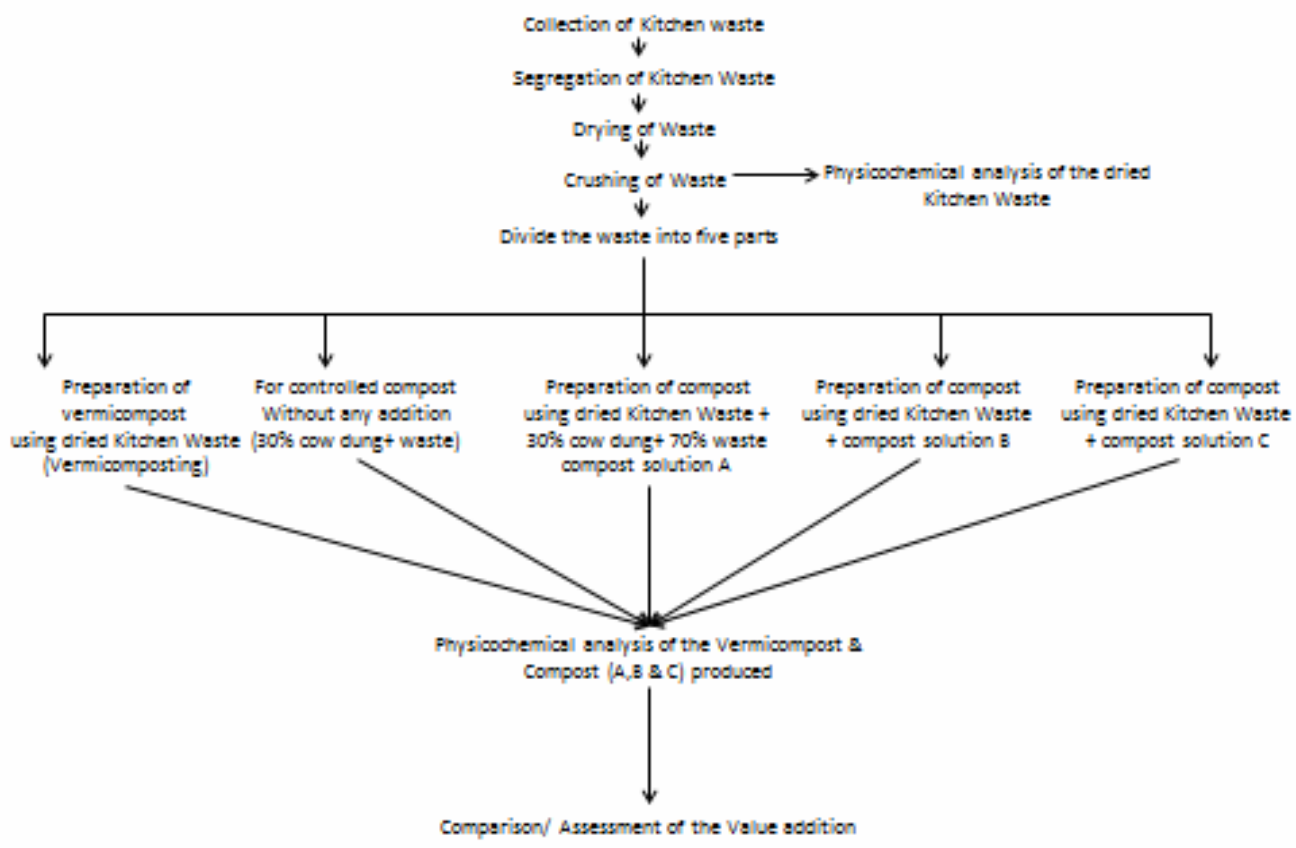
Collection of Kitchen waste
Segregation of Kitchen Waste
Drying of Waste
Crushing of Waste
Physicochemical analysis of the dried Kitchen Waste
Divide the waste into five parts
Preparation of vermicompost using dried Kitchen Waste (Vermicomposting)
For controlled compost Without any addition (30% cow dung+ waste)
Preparation of compost using dried Kitchen Waste + 30% cow dung+ 70% waste compost solution A
Preparation of compost using dried Kitchen Waste + compost solution B
Preparation of compost using dried Kitchen Waste + compost solution C
Physicochemical analysis of the Vermicompost & Compost (A,B & C) produced
Comparison/ Assessment of the Value addition

Fig.1. Schematic representation of the work plan

Statistical Analysis-

To test the level of significance of difference between the waste collected, the vermicompost, compost and compost produced by using A, B and C liquid composters with respect to the physicochemical parameters, two-way analysis of variance (ANOVA) will be computed.

SIGNIFICANCE

The proposed research work would embark on converting kitchen waste into a quality vermicompost and prepare a value added compost solution.

1. The Kitchen waste contains organic as well as inorganic matter and offers good possibilities for recovery of energy in its organic fraction for gainful utilization through adoption of suitable processing and treatment technologies.

2. Composting may offer some additional benefits also such as:

i. The total quantities of the generated waste get reduced.

ii. The known suitable kitchen waste which is mainly dumped in municipal waste can be converted into value added organic compost and vermicompost.

3. This project aims to prepare a value added solution (liquid composter) to convert kitchen waste into a useful product for better growth and quality of crops.

4. This research project thus has economic and environmental and hence societal relevance.

5. No chemicals are used in the production process.

6. Do not have any residual effect after application.

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